

## WHAT IS CLAIMED IS:

1. An optical fiber, comprising:  
a core and a cladding, said core including an alpha profile with an alpha parameter in the range of approximately 2 to approximately 8, a maximum index percent difference between the core and a cladding in the range of approximately 0.3% to approximately 0.5% and a core diameter in the range of approximately 6.0 to approximately 16.0  $\mu\text{m}$ ;  
wherein the optical fiber has a bandwidth of at least approximately 0.6 GHz.km at 850 nm and a cabled cut off wavelength in the range from about 1050 nm to 1300 nm.
2. The optical fiber of claim 1, wherein the core has a diameter in the range of approximately 6.0 to approximately 14.0  $\mu\text{m}$ .
3. The optical fiber of claim 1, wherein a maximum index percent difference between the core and the cladding is in the range of approximately 0.3% to approximately 0.4%.
4. The optical fiber of claim 1, wherein the core has an alpha parameter in the range from approximately 2 to approximately 4.
5. The optical fiber of claim 1, wherein the effective area is greater than 70  $\mu\text{m}^2$  at 1550 nm.
6. The optical fiber of claim 1, wherein the effective area is greater than 90  $\mu\text{m}^2$  at 1550 nm.
7. The optical fiber of claim 1, wherein the pin array bend loss is less than 4 dB at 1550 nm.
8. The optical fiber of claim 1, wherein the pin array bend loss is less than 2 dB at 1550 nm.

9. The optical fiber of claim 1, wherein the mode field diameter is greater than or equal to 10  $\mu\text{m}$ .

10. The optical fiber of claim 1, wherein an index profile of the core is configured in accordance with an operating wavelength, the bandwidth desired at the operating wavelength, and a length of the optical fiber.

11. The optical fiber of claim 10, wherein the index profile of the core is configured to have a peak bandwidth wavelength offset from the operating wavelength, the offset being sufficient to reduce intermodal noise.

12. The optical fiber of claim 1, wherein the alpha parameter is approximately 2, the maximum index percent difference between the core and the cladding is in the range from approximately 0.35% to approximately 0.4% and the core diameter is in the range from approximately 14.0 to approximately 16.0  $\mu\text{m}$ , to provide a waveguide fiber having, at 1550 nm, effective area greater than 90  $\mu\text{m}^2$ , and mode field diameter greater than 11  $\mu\text{m}$ .

13. The optical fiber of claim 12, wherein pin array bend loss is less than 2 dB at 1550 nm.

14. The optical fiber of claim 1, wherein the alpha parameter is approximately 3, the maximum index percent difference between the core and the cladding is in the range of approximately 0.35% to approximately 0.4% and the core diameter is in the range of approximately 12.0 to approximately 15.0  $\mu\text{m}$ , to provide a waveguide fiber having effective area greater than 85  $\mu\text{m}^2$ , and mode field diameter greater than 10.5  $\mu\text{m}$ .

15. The optical fiber of claim 14, wherein the pin array bend loss is less than 4 dB at 1550 nm.

16. The optical fiber of claim 1, wherein the alpha parameter is approximately 4, the maximum index percent difference between the core and

the cladding is in the range from approximately 0.3% to approximately 0.4% and the core diameter is in the range from approximately 12.0 to approximately 16.0  $\mu\text{m}$ , to provide a waveguide fiber having, at 1550 nm, an effective area greater than 85  $\mu\text{m}^2$ , and mode field diameter greater than 10.5  $\mu\text{m}$ .

17. The optical fiber of claim 16, wherein the pin array bend loss is less than 3.5 dB at 1550 nm.

18. An optical fiber, comprising:

a core; and

a cladding,

wherein the optical fiber is a multimode fiber at an operating wavelength and has a peak bandwidth wavelength offset from the operating wavelength and the offset is sufficient to substantially reduce intermodal noise at the operating wavelength.

19. The optical fiber of claim 18, wherein at the operating wavelength each mode has a group time delay and all of the group time delays are either all positive or negative, each of the group time delays being referenced relative to a lowest order mode ( $\text{LP}_{01}$  mode) associated with the optical fiber.

20. The optical fiber of claim 19, wherein at the operating wavelength each mode has a group time delay and the absolute value of the sum of the group time delay differences is greater than 0.

21. The optical fiber of claim 18, wherein the fiber is configured for multimode operation at a wavelength less than 1300 nm and single mode operation at a wavelength of at least approximately 1300 nm.

22. The optical fiber of claim 21, wherein a difference in a group time delay is at least one of all positive and all negative for all modes in the multimode operation of the optical fiber, each of the group time delay being

referenced relative to a lowest order mode ( $LP_{01}$  mode) associated with the optical fiber.

23. The optical fiber of claim 18, wherein the optical fiber is configured to have a bandwidth of at least approximately 0.6 GHz.km at 850 nm.

24. The optical fiber of claim 18, wherein the core has a diameter of in the range of approximately 6.0 to approximately 16.0  $\mu\text{m}$  and a maximum index difference between the core and the cladding is in the range of approximately 0.3 to approximately 0.5%.

25. A method of designing an optical fiber having a bandwidth of at least 0.6 GHz.km at 850 nm in multimode operation and being in single mode operation at a wavelength of at least approximately 1300 nm, comprising the steps:

a) determining for a given length of optical fiber a minimum difference between the operating wavelength and a peak bandwidth wavelength such that the difference in the optical path lengths of the modes in multimode operation is greater than at least one coherence length associated with a source utilized to launch light into the optical fiber at the operating wavelength; and

b) determining an index profile associated with the optical fiber in accordance with the minimum difference.

26. The method of claim 25, wherein determining a minimum difference includes calculating a speckle constant  $\gamma$  as a function of the bandwidth, a line width of the light, an intensity of the light, and the length of the optical fiber.

27. The method of claim 25, wherein determining a minimum difference includes having one of all positive or all negative differences in a

group time delay for all modes of the multimode operation, the group time delay referenced relative to any of the modes of the multimode operation.

28. The method of claim 25, wherein determining an index profile includes determining at least one of the operating wavelength, the bandwidth desired, and a length of the optical fiber during operation.

29. The method of claim 25, wherein determining an index profile includes configuring an alpha parameter associated with the optical fiber in the range from approximately 2 to approximately 8.

30. The method of claim 25, wherein determining an index profile includes configuring an alpha parameter associated with the optical fiber in the range from approximately 2 to approximately 4.

31. The method of claim 25, wherein determining an index profile includes configuring a maximum index difference in a core and a cladding of the optical fiber in the range from approximately 0.3 to approximately 0.5% and a diameter of a core of the optical fiber in the range from approximately 6 to approximately 16  $\mu\text{m}$ .

32. An optical fiber system comprising:

an optical fiber having a core and a cladding and a length, said core including an alpha profile with an alpha parameter in the range from approximately 2 to approximately 8, a maximum index percent difference between the core and the cladding in the range from approximately 0.3% to approximately 0.5% and a core diameter in the range from approximately 6.0 to approximately 16.0  $\mu\text{m}$ ;

a light source optically coupled to said fiber and having an operating wavelength, said optical fiber being multimode at the operating wavelength; wherein,

the alpha parameter, the maximum index percent difference and the core diameter are selected to provide a peak bandwidth wavelength of

said optical fiber that is offset from the operating wavelength by an amount sufficient to reduce intermodal noise at the operating wavelength.

33. The optical fiber of claim 32, wherein the length of the optical fiber is in the range of approximately 10 to approximately 20 m, an absolute value of the difference between the operating wavelength and the peak bandwidth wavelength is in the range of approximately 80 nm to approximately 150 nm, and the bandwidth is greater than approximately 0.6 GHz.km at the operating wavelength.

34. The optical fiber of claim 32, wherein the length of the optical fiber is in the range of approximately 20 m to approximately 100 m, an absolute value of the difference between the operating wavelength and the peak bandwidth wavelength is in the range of approximately 12 nm to approximately 80 nm, and the bandwidth is greater than approximately 1.2 GHz.km at the operating wavelength.

35. The optical fiber of claim 32, wherein the length of the optical fiber is in the range of approximately 100 to approximately 1000 m, an absolute value of the difference between the operating wavelength and the peak bandwidth wavelength is in the range of approximately 2 to approximately 12 nm, and the bandwidth is greater than approximately 2 GHz.km at the operating wavelength.

36. The optical fiber of claim 32, wherein the length of the optical fiber is greater than 1000 m, an absolute value of the difference between the operating wavelength and the peak bandwidth wavelength is greater than zero and less than approximately 2 nm, and the bandwidth is greater than approximately 3 GHz.km at the operating wavelength.